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Advanced C4I and Operational Decision Making: Panacea or Pandora's Box?

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College of the Department of the Navy.
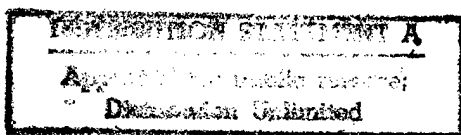
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This paper explores the promise of this "system of systems" as well as its week points. Specifically, the paper examines the interface between the joint warrior of the future and the advanced C4I systems that will empower the various service-specific and joint warfighting models being developed in support of *Joint Vision 2010*. Included is a discussion of how advanced C4I may or may not change decision making processes, particularly at the operational level of war. Finally, the paper examines methods which the military of the future might employ to meet the challenges these new technologies will create.

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Abstract of

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The much vaunted revolution in military affairs (RMA) as it relates to advanced Command and Control, Communications, Computers and Intelligence (C4I) is upon us. The notion that advanced C4I, fueled by rapid fire advancements in information technology, will be the ultimate answer to the fog and friction of war permeates the *C4I For The Warrior* concept. Such views are short sighted and fail to take into account the psychological factors that contribute to fog and friction.

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Thesis

The value added of virtual battle space awareness enabled by the next generation of

Command and Control, Communications, Computer and Intelligence (C4I) systems will

furnish the operational commander with the ability to observe, orient, decide and act

(OODA) with unprecedented rapidity. Given this potential ability to monitor with clarity,

events at both the operational and tactical levels of war, how will the future operational

commander keep the proper level of professional detachment required to formulate and

support the effective application of broadly based Operational Art concepts? In particular,

will the decision making processes on which the timely execution of operational branches and

sequels rests be enhanced or inhibited by the new C4I? In a digitized world, it is imperative

that the commander not be overwhelmed by too many viable options based on an

overabundance of "real time" data.

Introduction

This paper seeks to provide a warning to those who would see the much vaunted

revolution in military affairs (RMA), fueled by rapid fire advancements in information

technology, as the ultimate answer to the fog and friction of war. It will examine both the

promise of this "system of systems"[1] as well as its week points. Specifically, the paper will

examine the interface between the joint warrior of the future and the advanced C4I systems

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[1] Owens, William A. "The Emerging System of Systems," U.S. Naval Institute Proceedings, May 1995, 35-39.

that will empower the various service-specific and joint warfighting models being developed in support of *Joint Vision 2010*. Included will be a discussion of how advanced C4I may or may not change decision making processes, particularly at the operational level of war. Finally, the paper will examine methods which the military of the future might employ to meet the challenges these new technologies will create, as they in turn, are employed to solve the problems of fog and friction.

"Know the enemy and know yourself ; . . .

. . . in a hundred battles you will never be in peril."[2] When Sun Tzu made that assertion some 1500 years ago, he unwittingly captured the essence of the C4I architecture that will enable "network-centric warfare." [3] The idea that a commander can know with near absolute certainty, in real time, the disposition of both enemy and friendly forces would undoubtedly have met with the ancient warrior-philosopher's approval. To translate that knowledge almost instantaneously into actions which mass, not forces as Sun Tzu knew the term, but "effects," both lethal and non-lethal, which not only win battles but possibly even wars, must be seen as a true RMA.

It is not a matter of "if" we will engage in network-centric warfare, nor even of "when." The "future is now," for the individual services are engaged in various experiments intended to flesh out the template provided by *Joint Vision 2010*. While the contributory subsets being developed by the services (e.g. the Army's Force XXI and the Marine Corps' Operational Maneuver From The Sea) retain the essential aspects of their core competencies,

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[2] Sun Tzu, The Art Of War. (Oxford, England: Oxford University Press 1963) 84.

they have the following attributes in common: 1) They will leverage technology to ensure the force has the requisite advantage to preclude conflict if possible, but to win decisively if necessary. 2) They will employ the multidimensional application of information, engagement, and mobility capabilities to position and employ widely dispersed joint air, land, sea, and space forces to accomplish assigned operational tasks. 3) They will utilize a "system of systems" that enables joint forces to locate the objective or target, provide responsive command and control, generate the desired effect, assess the level of success, and retain the flexibility to reengage with precision when required. 4) They will control the battlespace to ensure our forces can maintain freedom of action during deployment, maneuver, and engagement while providing multilayered defenses for our forces and facilities at all levels. 5) They will provide focused logistics that will fuse information, logistics, and transportation technologies to provide rapid crisis response, to track and shift assets even while en route, and to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical levels of operations. 6) They will establish information superiority (the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same).[4] In the aggregate, such warfighting concepts will enable the warrior of the future to operate at a faster tempo or rhythm than that of his adversary, thereby generating confusion and disorder - in

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[3] Cebrowski, Arthur K. and Garstka, John J. "Network-Centric Warfare: Its Origin and Future," U.S. Naval Institute Proceedings, January 1998, 29.
[4] Joint Chiefs of Staff, Joint Vision 2010 (Washington: GPO) 1-33.

effect, getting inside the enemy's OODA loop and causing Command and Control (C2) paralysis. [5]

The engine which drives this particular RMA is the continually improving capability of digital processing systems. The average person familiar with personal computers knows that the regularity of processor, storage design and software innovation practically relegates newly purchased machines to obsolescence almost as soon as they are out of the box. That notwithstanding, it is these developments in the civilian sector which will provide much of the flexibility and interoperability that this RMA demands. According to Professor Nicholas Negroponte of MIT, "Computing is no longer the exclusive realm of military, government, and big business. It is being channeled into the hands of very creative individuals at all levels of society, becoming the means for creative expression in both its use and development. . . Consumer products will be the driving force."[6] One example of this can be seen in the results of Joint Warfare Interoperability Demonstrations (JWID) 97, where commercial off-the-shelf (COTS) software provided network management and electronic mail for a Coalition Wide Area Network (CWAN) which "provided a very reliable means of communication among the Coalition sites . . . Every site praised the CWAN for providing superior infrastructure and allowing Real Time Collaborative Planning (RTCP) among all Coalition participants."[7] One can well imagine the advances that will occur in such COTS software applications between now and 2010, as well as their subsequent utility in planning procedures.

[5] Boyd, John R, A Discourse On Winning And Losing (An Unpublished Lecture Given At The Air War College 1987)
[6] Negroponte, Nicholas, Being Digital (New York: Vintage Books 1995) 82.
[7] Director, Joint Warrior Interoperability Demonstration Joint Project Office. "JWID97 FINAL REPORT." JWID97 CONTROL ROOM 14 July 1997. < //www.jwid97.bmpcoe.org/control.html/>

There is, in fact, little question that joint planning processes, both deliberate and crisis response, stand to benefit greatly from these advances. It is not difficult to imagine a geographic CINC, in receipt of a tasking from the National Command Authority (NCA), being able to call upon massive data bases, continuously updated with real time information provided by all manner of sources, ranging from the latest satellite imagery to up-to-the-minute performance of the regional stock market, to aid in the shaping of his or her "battlespace."[8]

At the Theater Strategic and Operational levels of war, this shaping must be expanded beyond purely military interests. After all, as Sun Tzu said "To subdue the enemy without fighting is the acme of skill."[9] Indeed, shaping of the battlespace as deterrence may well require future operational commanders to pull, or have pushed to them, critical data from the "infosphere"[10] that takes into account all manner of political, cultural, economic and military phenomena in order to shape their battlespace in a manner which subdues an enemy without a fight. This shaping might be accomplished by targeting and eliminating the causes of tension outright, or by the commander recommending to the NCA, ways in which this might be accomplished by other national assets or by non-governmental organizations (NGOs) and private volunteer organizations (PVOs). Should this proposed shaping of the battlespace as

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[8] Joint Chiefs of Staff, "Committed, Focused and Needed" C4I For The Warrior (Washington: GPO 1993) 9. The proffered definition of "battlespace" is any area over which the Warrior exercises control or has a military interest.

[9] Sun Tzu, 77.

[10] Joint Chiefs of Staff, "Committed, Focused and Needed" C4I For The Warrior, 10. The Infosphere is a global network of military and commercial communications systems and networks linking information data bases and fusion centers that are accessible to the warrior anywhere, anytime, in the performance of any mission.

deterrence fail, "the continuation of policy by other means"[11] becomes necessary. The Combatant Commander's Estimate process, which in theory is continuous,[12] could be re-designed to instantaneously provide Operational Concepts and potential Courses of Action based on desired Strategic End States for any number of given situations, anticipated or otherwise. Preliminary planning could thus be accelerated and critical actions set in motion far more quickly than is now possible. This process could then be seamlessly linked to the Joint Operation Planning and Execution System (JOPES) of the future. The JOPES system currently:

> "governs all aspects of conventional joint military operations planning and execution. It is the tool used by all echelons of planners and operators to speak a commonly understood language. . . JOPES furnishes joint commanders and war planners at all levels standardized policies, procedures, and formats to produce and execute a variety of required tasks to include: Planning — writing operation plans (OPLANs), operation plans in concept format (CONPLANs), functional plans, campaign plans, and operation orders (OPORDs); and execution and deployment (time-phased force and deployment data [TPFDD]) management — defining requirements for, and gaining visibility of, the movement of forces into the combatant commanders' area of responsibility (AOR)."[13]

Envisioned in both of the Joint Chief's Publications *User's Guide for JOPES* and *C4I For The Warrior* is a robust Global Command and Control System (GCCS). "GCCS is the embodiment of the Command, Control, Communications, Computers and Intelligence (C4I) for the Warrior concept. *C4I for the Warrior*, through GCCS, will provide the necessary information for warfighters to fight and win on battlefield today and in the future."[14] Already in operation is a rudimentary form of the GCCS envisioned in the

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[11] Clausewitz, Carl von, <u>On War</u>. (Princeton, NJ: Princeton University Press 1976) 87.
[12] Joint Chiefs of Staff, <u>Joint Pub 3-0: Doctrine for Joint Operations</u>. (Washington: GPO 1995) I-8.
[13] Joint Chiefs of Staff, <u>User's Guide for JOPES</u>. (Washington: GPO 1995) i.
[14] Ibid, 18.

concept, which with the JOPES Automated Data Processing (ADP) system provides

some planning and execution capability. In the future it is anticipated that:

> ". . . modifcations. . . will modernize JOPES ADP and combine its capabilities with other C2 systems to form a more powerful, integrated tool for warplanning. Upgrades to JOPES capabilities will provide the warfighter the tools to support execution as well as planning. Along with many other capabilities, GCCS will integrate: Deliberate and Crisis Action Planning; Force Deployment and Employment; Fire Support; Air Operations and Planning; and Intelligence."

In short, it is conceivable that the time required to generate a fully mature campaign or

Joint Operation Plan, from initial tasking to final approval by higher authority, will be

significantly reduced , perhaps to only a few hours. Indeed, we have already witnessed a

vestigial example of such a planning system during the Taiwan Straights crisis of 1995 when

Vice-Admiral Clemins, Commander, U.S. Seventh Fleet and his staff utilized "e-mail, a very

graphic rich environment, and video teleconferencing" [15] to reduce their planning time lines

from days to hours.

While the pre-hostility planning process is critically important, the real thrust of this

discussion is the impact of advanced C4I once first contact with the enemy is achieved. It is

at this time, when the initial stages of the operation are complete and the situation is most

fluid that branches in the basic operations plan become crucial. These options "add

flexibility to plans by anticipating situations that could alter the basic plan. Such situations

could be the result of enemy action, availability of friendly capabilities or resources, or even a

change in weather or season within the operational area."[16]

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[15] Cebrowski and Garstka, 33.
[16] Joint Chiefs of Staff, Joint Pub 3-0: Doctrine for Joint Operations, III-20.

No less crucial are sequels and at the campaign level, phases. Sequels are "subsequent operations based on the possible outcomes of the current operation."[17] Together, carefully pre-planned branches and sequels have long been the hallmark of successful operation and campaign plans. The U.S. Army's *Operations Manual* FM 100-5 points to the contemporary example of VIII Corps during Operation Desert Storm and their planned combination of seven branches and sequels designed to maintain offensive momentum regardless of Iraqi actions.[18]

The implied promise of *C4I for the Warrior* is that branches and sequels will not only be well gamed in advance of hostilities, but as new and unanticipated opportunities present themselves in the commander's battlespace, the operational commander's superior situational awareness will make possible the creation of entirely new branches and sequels based on real time data. These can be quickly wargamed with regard to enemy Courses of Action and the resulting Fragmentary (FRAG) Orders rapidly generated and disseminated to subordinate commanders. It is anticipated that such real time awareness and rapidity of action across the entire length and breath of the battlespace will cause OODA loop paralysis in the enemy command structure.

While it is clear the technology exists now, or will shortly, to fight a network-centric war, it is not clear that we know yet "how" to fight one. This is a particularly significant concern as the positive attributes of the advanced C4I systems described in the preceding paragraphs threaten to blur the dividing lines between tactics and operational art in a

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[17] Ibid.
[18] Headquarters, Department Of The Army. Operations (FM 100-5) Washington, DC: 1993, 6-9.

blizzard of digitized information and precision guided munitions delivery capability. While each service is engaging in service-specific experiments in "battle labs" and joint endeavors such as the JWIDs, the possibility exists that the technology being leveraged to empower the *Joint Vision 2010* concept is outstripping the development of training regimens and doctrine needed to plan and fight a network-centric war.

"The Paradox of the Learned Ignoramus"[19]

It is critical that we as a joint force come to grips with the problem of doctrine and training as there is at least one major pitfall attendant to *C4I For The Warrior* which advanced technology is not in position to address. This hazard is two fold, and involves human psychology in both instances. The first instance is much more insidious than anything our enemies could conceive or execute via C4I Warfare (C4IW). The *paradox of the learned ignoramus* refers to the inability of a well informed person to make intelligent choices when faced with numerous options, all of which are feasible and executable. According to Professor Robin M. Hogarth of the University of Chicago Graduate School of Business, " . . . a key aspect of choice is human incapacity to process information. We simply cannot handle all of the information inherent in complex choice situations and, in particular, to make the many kinds of trade-offs implied by choices involving several conflicting dimensions."[20] The "conflicting dimensions" to which Hogarth was referring are varied, task dependent and potentially unlimited in number (e.g. a gambler might weigh probability vs. amount in the pot

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[19] Try as I might, I was unable to find the name of the academic who postulated this concept. I was first exposed to it in 1976 during an undergraduate Political Science course. I attempted to contact the professor who taught the course via e-mail so that I might properly attribute the quote, but have yet to receive a response.
[20] Hogarth, Robin M.. Judgment and Choice: The Psychology of Decision (Chichester, England: John Wiley & Sons 1980) 73.

in deciding if and how much he should bet). People tend to focus on one or a limited number of "conflicting dimensions" at the expense of others. A commander might treat the factors of time-space-forces as "conflicting dimensions" which would require an assessment of potential trade-offs in the decision making process.

The proponents of information technology believe that the speed with which information can be acquired, processed, collated and disseminated will accentuate the decision making process. After all, if one takes less time in the acquisition and assimilation of information, it should logically follow that one can take a little more time to arrive at a good decision. However, as professor James G. March of Stanford University points out:

> . . . the modern world is usually described as stimulus-rich and opportunity-filled. There are more things to do than there is time to do them, more claims on attention than can be met. The importance of scheduling and time, and concerns about "information overload," are distinctive complaints. . . The problems are conspicuously not ameliorated by information technology. Time pressures are further dramatized and probably accentuated by telefaxes, car phones, and systems of electronic mail. Computers seem to have done more to increase information load than to reduce it.[21]

Professor March was referring to concerns in the civilian sector, but should we expect the problems he identified to be any less debilitating in the "stimulus-rich and opportunity filled" world of the digitized battlespace?

The authors of *C4I For The Warrior* are banking that much of this overload will be mitigated by "fusion," the process of "receiving and integrating all-source, multi-media and multi-format information to produce and make available an accurate, complete summary that is timely, but more concise, less redundant, and more useful to the warrior than if the same

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[21] March, James G. A Primer on Decision Making (New York: The Free Press 1994) 23-24.

information were received directly from several multiple sources."[22] This would appear to be one answer to the problem. However, these same authors are betting that this fusion process will be facilitated by Artificial Intelligence (AI) techniques that are still in their early developmental stages. AI pioneer Marvin Minsky has pointed out that "while today's computers can exhibit an uncanny grasp of airline reservations (a subject almost beyond logic), they absolutely cannot display the common sense exhibited by a three- or four-year-old child."[23] Short of major breakthroughs in AI development, fusion as visualized may not pan out.

Also attendant to the human decision making process are the factors of ambiguity and uncertainty. According to Professor Paul C. Nutt of Ohio State University, "Ambiguity occurs when important factors are either unclear or unknown, as contrasted with uncertainty, in which important factors are clear but making a prediction using a factor is not."[24] In the event, despite the abundance of information that is promised and the potential Courses of Action laid out, a commander may still delay in the making of a critical decision. There are two very important reasons stemming from ambiguity and uncertainty for why this is so: a) he cannot be sure that the action he takes (e.g. employment of a branch or sequel or application of an operational fire) will in fact achieve the desired effect; and b) that he cannot execute the decision for want of that "one more piece of critical information." What ensues is "paralysis by analysis."[25]

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[22] Joint Chiefs of Staff, C4I For The Warrior, 3.
[23] Negroponte, 156.
[24] Nutt, Paul C, Making Tough Decisions (San Francisco: Jossey-Bass Inc 1989) 7.
[25] Rogers, Charles T, Intuition: An Imperative Of Command (Military Review March 1994) 45.

As indicated above the major psychological hazard attendant to advanced C4I and decision making is two fold. The second area of concern dealing with human behavior is the tendency to seek a level of comfort in familiar surroundings. That because a senior officer carries the reputation for having been a great battalion commander or ship's commanding officer, he might feel that such notoriety gives license to introduce himself into that lower echelon for purposes of micro-management. One is reminded of C.S. Forrester's *The General*, in which the protagonist, a newly breveted British general officer, takes special care in the inspection of the cook houses under his purview because that is what his previous experience best prepared him for. [26] The rest of his command may be falling down about his ears, but he has the best cook houses in the British Army. The very real concern is that a Joint commander, particularly if he retains operational control of the component in which he has particular expertise, might be drawn down into tactical minutia simply because the C4I system allows him to be.

Were a time warp to allow *C4I For The Warrior* to be transported back to 1944, ADM Chester Nimitz would not have had to ask the inflammatory question "Where is Task Force 34?" of ADM William F. Halsey at Leyte Gulf. He would know precisely where Task Force 34 was as well as the course, speed, defensive disposition, fuel state and munitions status of every ship in the force, and any other information he deemed pertinent. He would know the whereabouts and capabilities of the opposition as well. With that ability, no leader would be immune from issuing rather pointed "rudder orders" to his subordinate in the heat of battle. Obviously, a little micro-management on the part of Nimitz

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[26] Forester, C.S. The General (Middlesex, England: Penguin Books 1936) 92.

in this case would have improved the situation. But is this always a good thing? According to Craig Brod: "The ability to accomplish a task often creates the need to execute that task — often too frequently."[27] It is quite possible that *C4I For The Warrior* might give rise to a generation of "chateau generals," [28] who wield power from afar in mistaken confidence that the real time information provided by the infosphere gives them the sense of immediacy experienced by the people on the front lines. Worse yet, it might spawn a generation of subordinates who gain no confidence in their own abilities because "big brother" is always watching.

The crucial point that the reader should take away from this section is that the one element in the system that technology cannot yet overhaul with impunity is human psychology and its associated flaws.

Some Ruminations On How To Make This Work

We cannot yet create a totally digital-decision maker, devoid of that which makes us human. Perhaps this is not a bad thing to keep in mind when trying to generate fixes for a system that is not yet in use amongst the "rank and file" members of the military. After all, it is our humanity that makes wars possible in the first place. Because of that, we need to take a long hard look now and not later on how we can build doctrine, training programs and decision support programs that take these human factors into account if we are to properly employ *C4I For The Warrior*.

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[27] Brod, Craig, Technostress: The Human Cost Of The Computer Revolution (Reading, MA: Addison-Wesley Publishing Co. 1984) 67.
[28] Keegan, John, The Mask Of Command (London: Penguin Books Ltd. 1988) 316, 326-328.

As previously mentioned, the services and the Joint community are conducting battle labs and demonstrators in an effort to come to grips with the technical challenges anticipated in the evolution of this system of systems. As much if not more attention must be paid to the mental challenges that will present themselves. One such area that is receiving attention, at least from the Navy, is Tactical Decision Making Under Stress (TADMUS). TADMUS is a project aimed at understanding how officers make decisions in an environment containing a great deal ambiguity and uncertainty, in order to help either with better training of teams and individuals, or with the design of better Human-Computer Interfaces or Decision Support Systems (DSS). The objective of the entire TADMUS project, is to generate principles to help decision makers overcome acute stressors (e.g. rapidly evolving and ambiguous scenarios, complex/multi-component decisions, information overload, auditory overload, command pressure, threat, adverse physical conditions, and rapid interaction requirements), in a variety of Navy and other military tasks.[29]

Born of the *Vincennes* tragedy, TADMUS has, for the past five years, exposed both trained ship's Combat Information Center personnel and novice students at Surface Warfare Officers School Command (SWOS) to scenarios not unlike that which resulted in the accidental downing of the Iranian Airbus in 1988. Funded by the Office of Naval Research and Development, the totality of the TADMUS team's findings thus far is well beyond the scope of this paper. However, the one item that has prominence as far as this discussion is concerned is the DSS developed by the Navy's Space and Naval Warfare Center (SPAWAR).

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[29] Cannon-Bowers, Janis A., Hall Johnston, Joan, Smith-Jentsch, Kimberly A. "Event-Based Performance Measurement System." Office of Naval Research and Development Homepage. June 1995. <//www.ott.navy.mil/2_1/2_1_4/ebfp.htm>

The DSS allows a Commanding Officer or Tactical Action Officer (TAO) to "click" on a contact and have presented its course, speed, emitters and altitude (ascending or descending) compared with the attack profiles and emitters of known threats. Also provided is the DSS's evaluation of the threat level based on the comparison. In short, an Airbus climbing toward a commercial air corridor will not likely be mistaken for a Super Entendard descending to release an Exocet missile. Personal observation of one of the latest experiments using the DSS at SWOS during the week of 27 April 1998 left me absolutely convinced that such a system, once expanded beyond its tactical application, has utility in combating information overload at the operational level of war. Instead of flight profiles and the like, information about the capabilities of a particular enemy force as compared to that of a friendly, or the potential efficacy of a proposed operational fire might be graphically presented to the operational commander. This information along with recommended Courses of Action, and potential Measures of Effectiveness etc., would do much to assuage concerns generated by uncertainty and ambiguity.

Another area of concern *vis-à-vis* doctrine and force shaping is command structure. In their article *Leaving The Technocratic Tunnel*, Gary Anderson and Terry Pierce refer to the present command structure as the "centralized detail-control model"[30] with the CINC or JTF commander at the top and several intervening echelons between them and the shooters. They suggest that more complex C4I systems will result in a "flattening" of the military hierarchy which would , in effect, remove several echelons from the chain of command and

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[30] Anderson, Gary W. and Pierce, Terry C., "Leaving The Technocratic Tunnel," Joint Force Quarterly Winter 95-96, 71-73.

result in more decentralized control. While in some respects the flattening concept makes sense, given the capabilities of the proposed C4I systems, it is disturbing that so much responsibility (often for actions that will impact the outcome of major operations) will rest on our least experience people. Contrary to Anderson and Pierce's assertions, this relative lack of experience on the part of lower echelon leaders cannot help but cause the flattening effect to resemble a spider's web and will result, paradoxically, in more centralization rather than less.

One negative corollary of this flattening paradox, should it come to pass, is that squad leaders do not become CINCs overnight and that the reason we have the hierarchical system we do is so that junior people learn and gain experience at different levels of command before the President nominates them to be a CINC. It is only through experience that the intuitive aspect of decision making is developed and improved. When all is said and done, experience counts and even in a network-centric war there is a place for Clausewitz's *coup d'oeil*. Should we choose to go down the road to a flattened hierarchy, we need to develop a long range training plan that will result in a Flag or General Officer fully capable of assuming a CINC or JTF assignment without benefit of the developmental system now extant.

A second negative corollary of the flattening paradox is the concern over how many echelons down should an operational commander be able to delve before his actions become intrusive and counter-productive. One is reminded of the scene in the film *Apollo 13*, where Tom Hanks (playing astronaut Jim Lovell) angrily rips the devices providing medical telemetry to the Earth-based flight surgeon because of the constant kibitzing concerning the surgeon's concern for the crew's lack of sleep. One can imagine a similar scenario in which a

Marine Corps "Sea Dragon"[31] squad leader, theoretically entrusted with the ability to employ tactical and even operational fires, hangs up (or logs off) on the CINC because he is just too busy to chat.

One suggestion to cope with this phenomenon would be digital set points which would evaluate the amount and kind of sensory load a particular unit is carrying, compare that data to preset parameters decided upon by the commander and his staff, calculate the necessity or desirability for intervention on the part of higher authority, and cue the commander to act. In this way, an anxious commander might be dissuaded from interfering until the parameters for action are met.

In the event, whether the present hierarchy is retained or flattened, the doctrine which defines the organization and its C4I architecture must be developed now so that the CINCs of 2010 and the squad leaders not yet in the military will train to the same paradigm.

While AI may not have the common sense of a 3- or 4-year-old child now, research must nonetheless continue in that field for there is where advanced C4I can realize the biggest return on our nations investment. While some may be uncomfortable with the idea of sentient machines, the promise of what such a system can provide *C4I For The Warrior* is enormous.

Let us return for a moment to the GCCS/JOPES interface and the continuous updating attendant to the Commander's Estimate process. The updating of such a system could be performed by digital "interface agents";[32] an emerging form of AI which learns and develops

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[31] Ibid, 75.
[32] Negroponte, 154-156.

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over time, not unlike the staff member whose knowledge of the theater and operational concepts is optimized just about the time he or she is transferred. This digital staff member in theory would never leave and would only get smarter. Such a system could be designed to be "dialable" in nature. That is, a newly assigned CINC may want to pull all the data available from infosphere concerning a particular country or theater, or "dial" down the amount of data to that which he deems to be truly critical based on his experience. A digital "interface agent" might even *learn* to anticipate increased or decreased interest in a particular subject on the part of the CINC based on certain cues and provide tailored information accordingly.

Conclusion

Properly utilized, advanced C4I will grant the joint warrior advantages long dreamed of amongst those who practice the profession of arms. The potential to not just paralyze the adversary's OODA loop but to obliterate it exists, and will only become more powerful. In the digitized world of the future it will be possible for operational commanders to keep the proper level of professional detachment required to formulate and support the effective application of broadly based Operational Art concepts, but only if we act now to ensure that they do not mistake technological hubris for military genius. Training, doctrine and experience will always serve to bring order to the chaos that even the best C4I system cannot overcome.

Bibliography

Agor, Weston A. The Logic Of Intuitive Decision Making. New York: Quorum Books, 1987

Barrett, Linda E. Decision Making Teams: Their Study In The Military. East Lansing, Michigan: Michigan State University, 1993

Barwick, Sydney K. Stress And The Military Pilot. Alexandria, VA: Defense Technical Information Center, 1988

Beach, Lee Roy. The Psychology Of Decision Making: People in Organizations. Thousand Oaks, CA: Sage Publications, 1997

Brinkers, Henry S. ed. Decision-Making: Creativity, Judgment, and Systems. Columbus, OH: Ohio State University Press, 1972

Brod, Craig. Technostress: The Human Cost Of The Computer Revolution. Reading, MA: Addison-Wesley Publishing Co., 1984

Boyd, John R. A Discourse On Winning And Losing. An Unpublished Lecture Given At The Air War College, 1987

Cannon-Bowers, Janis A., Hall Johnston, Joan, Smith-Jentsch, Kimberly A. "Event-Based Performance Measurement System." Office of Naval Research and Development Homepage. June 1995. <//www.ott.navy.mil/2_1/2_1_4/ebfp.htm>

Cebrowski, Arthur K. and Garstka, John J. "Network-Centric Warfare: Its Origin and Future," U.S. Naval Institute Proceedings, January 1998

Clausewitz, Carl von. On War. Princeton, NJ: Princeton University Press, 1976

Director, Joint Warrior Interoperability Demonstration Joint Project Office. "JWID97 FINAL REPORT." JWID97 CONTROL ROOM 14 July 1997. <//www.jwid97.bmpcoe.org/control.html/>

Dotterway, Kristen Ann. Systematic Analysis Of Complex Dynamic Systems: The Case Of The USS Vincennes. Alexandria, VA: Defense Technical Information Center, 1993

Fallesen, Jon J., Lussier, James W., Michel, Rex R., and Pounds, Julia. Practical Thinking: Innovation in Battle Command Instruction. Ft. Belvoir, VA: Defense Technical Information Center, 1996

Festinger, Leon. Conflict, Decision, and Dissonance. Stanford, CA: Stanford University Press, 1964

Bibliography

Forester, C.S. The General. Middlesex, England: Penguin Books, 1936

Headquarters, Department of the Army, Operations (FM 100-5), Washington, DC: 1993

Hogarth, Robin M. Judgement and Choice: The Psychology of Decision. Chichester, England: John Wiley & Sons, 1980

Joint Chiefs of Staff. "Committed, Focused and Needed" C4I for the Warrior. Washington, GPO: 1993

Joint Chiefs of Staff. C4I for the Warrior. Washington, GPO: 1993, 1994.

Joint Chiefs of Staff. Joint Warfare of the Armed Forces of the United States. (Joint Pub 1) Washington: GPO, 1995

Joint Chiefs of Staff. Doctrine for Joint Operations. (Joint Pub 3-0) Washington: GPO, 1995

Joint Chiefs of Staff. Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations. (Joint Pub 6-0) Washington: GPO, 1995.

Joint Chiefs of Staff. User's Guide for JOPES. Washington: GPO, 1995

Joint Chiefs of Staff. Joint Vision 2010. Washington, D.C.

Keegan, John. The Mask Of Command. London, England: Penguin Books Ltd., 1988

Linstone, Harold A. Multiple Perspectives For Decision Making. New York: North-Holland, 1984

March, James G. A Primer on Decision Making. New York: The Free Press, 1994

Negroponte, Nicholas. Being Digital. New York: Vintage Books, 1995

Nutt, Paul C. Making Tough Decisions. San Francisco: Jossey-Bass Inc., 1989

Nye, Joseph S. and Owens, William A. "America's Information Edge." Foreign Affairs, Vol. 75, No. 2, March/April 1996

Owens, William A. "The Emerging System of Systems." U.S. Naval Institute Proceedings, May 1995, 35-39.

Bibliography

Reilly, Gregory D. <u>How Tactical Experience Affects Confidence About Combat Decision Making</u>. Ft Belvoir, VA: Defense Technical Information Center, 1984, 1997

Rogers, Charles T. "Intuition: An Imperative Of Command." <u>Military Review</u>, March 1994

Smith, Perry M. <u>Taking Charge: Making The Right Decisions</u>. Garden City Park, New York: Avery Publishing Group Inc., 1993

Sun Tzu. <u>The Art Of War</u>. Oxford, England: Oxford University Press, 1963

Van Creveld, Martin. <u>The Transformation Of War</u>. New York: The Free Press, 1991

Van Creveld, Martin. <u>Technology and War</u>. New York: The Free Press, 1991